Seat No.	

Set P

M.Sc. Physics (Energy Studies) (Semester - I) (New) (NEP CBCS)
Examination: March/April - 2025
Mathematical Physics (2322101)

Day & Date: Thursday, 15-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) Which of the following is NOT an algebraic operation in complex numbers?
a) Addition b) Exponential
c) Multiplication d) Division

2) Cauchy's Integral Theorem states that:
a) The integral of a function along a closed contour is zero
b) The integral of a function along a closed contour is nonzero
c) The integral of a function along a contour depends on the contour itself
d) The integral of a function along a contour is infinity

3) The Fourier transform of a Gaussian distribution in the time domain results in a:
a) Gaussian distribution in the frequency domain
b) Sine function in the frequency domain
c) Cosine function in the frequency domain
d) Delta function in the frequency domain

4) In the Fourier series representation of a square wave, the coefficients corresponding to odd harmonics are:
a) Zero b) Non-zero
c) Constant d) Negative

5) The number of arbitrary constants in the general solution of differential equation of second order is ____.
a) 1 b) 0
c) 2 d) 4

6) The non-zero Particular Integral can be found out for _____ differential equation.
a) Homogeneous b) Non-Homogeneous
c) Second order Homogeneous d) None of these

7) In Hilbert space, which property does the inner product satisfy?

a) Anticommutativity b) Distributivity

c) Additivity d) Associativity

8) The rank of the zero matrix?

a) 0 b) 1

c) -1 d) The rank is undefined

B) Write True or False. **04**

a) A set of functions is a complete orthogonal set if any function in the set can be expressed as a linear combination of the others.

b) The Wronskian of a set of solutions to a second-order homogeneous equation with constant coefficients is always zero.

c) Cauchy's Integral Formula expresses the value of a function at a point in terms of its contour integral.

d) The Fourier series expansion of a square wave contain only cosine terms.

Q.2 Answer the following question (Any Six) **12**

a) Show that given matrix is unitary matrix $A = \begin{bmatrix} i & 0 \\ 0 & 1 \end{bmatrix}$

b) Find the Norms of given equation $f(t) = t + 2$

c) Define De-Moivre's theorem by exponential function.

d) Solve $f(z) = \frac{\sin z}{z}$

e) Solve $4\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + y = 0$

f) Find $L(te^{2t})$

g) Define in a_0, a_n *and* b_n in Fourier series.

h) Find, the Residue of $f(z) = \frac{z^2}{Z^2+a^2}$

Q.3 Answer the following question (Any Three) **12**

a) Consider the function $f(z) = \oint \frac{e^z}{Z^2-2Z+2}\, dz$

i) Determine the singular points of $f(z)$.

ii) Calculate the residues at each of the singular points

b) Describe Argand Diagram.

c) Determine linear independence of following Set
$S = \{(1,-1,2),(1,-2,1),(1,1,4)$

d) Solve $9\frac{d^2y}{dx^2} + 12\frac{dy}{dx} + 29y = 0$

Q.4 Answer the following question (Any Two) **12**

a) Solve the differential equation $\frac{dy}{dx} + ycotx = \cos x$

b) Evaluate the integral $f(z) = \oint \frac{\sin(z)}{Z^2+4}\, dz$ where, C is the circle $|Z| = 3$ traversed counterclockwise.

c) Determine whether the following in R^3 is linearly independent.

$\{(1,-2,1),(2,1,1),(7,-4,1)\}$

Q.5 Answer the following (Any Two) **12**

a) Find $L(te^{-2t}\sin 2t \sin 3t)$

b) Solve $\frac{d^2y}{dx^2} - 10\frac{dy}{dx} + 25y + 0$

c) Find the inverse of a matrix $A = \begin{bmatrix} 7 & 2 & 1 \\ 0 & 3 & -1 \\ -3 & 4 & -2 \end{bmatrix}$

Seat No.	

Set P

M.Sc. Physics (Energy Studies) (Semester - I) (New) (CBCS) Examination: March/April - 2025
Solid State Physics (2322102)

Day & Date: Saturday, 17-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) The Bloch theorem is crucial for understanding_____
a) Dielectric properties b) Band structure in solids
c) Superconductivity d) Paramagnetism

2) The Meissner effect demonstrates_____
a) Perfect diamagnetism in superconductors
b) Magnetic susceptibility in ferrites
c) Curie-Weiss behavior in paramagnetism
d) None of the above

3) The Neel temperature is associated with ____.
a) Superconductivity b) Antiferromagnetism
c) Ferrimagnetism d) Ferroelectricity

4) Which type of polarization is due to the distortion of the electron cloud?
a) Ionic b) Orientational
c) Electronic d) Dielectric

5) The Kronig-Penney model explains:
a) The energy gap in semiconductors
b) Susceptibility in magnetic materials
c) Polarization mechanisms
d) None of the above

6) Superconductivity is destroyed at ____.
a) Low temperatures b) High magnetic fields
c) Room temperature d) Low pressures

7) Ferrimagnetic materials are characterized by ____.
a) Equal and opposite spins b) Unequal opposing spins
c) Random spin alignment d) None of the above

8) The Clausius-Mossotti equation relates
a) Magnetic permeability and susceptibility
b) Polarizability and dielectric constant
c) Electrical conductivity and temperature
d) None of the above

B) Fill in the blanks: **04**
1) The energy bands in solids arise due to the ____ potential.
2) Superconductors exhibit perfect diamagnetism due to the ____ effect.
3) Antiferromagnetic materials have a critical temperature called the ____.
4) The ____ equation is used to calculate the internal field in a dielectric.

Q.2 Answer the following (Any Six). **12**
a) Explain the motion of electrons according to band theory.
b) Discuss the significance of the Meissner effect in superconductors.
c) What is the Curie point?
d) Explain the electronic polarization in dielectrics.
e) Write about the energy gap in semiconductors.
f) Differentiate between Type I and Type II superconductors.
g) Classify the magnetic materials.
h) Explain the Bloch wall.

Q.3 Answer the following (Any Three). **12**
a) Derive the London equations in superconductivity.
b) Describe the electrical conductivity in metals.
c) Write about the Langevin theory of paramagnetism.
d) Discuss the Brillouin zones.

Q.4 Answer the following (Any Two). **12**
a) Derive the Clausius-Mossotti equation.
b) Explain the dipole theory of ferroelectricity.
c) Write a note on saturation magnetization and its temperature dependence.

Q.5 Answer the following (Any Two). **12**
a) Describe the Josephson effect and its applications.
b) Discuss the thermodynamics of superconductors.
c) Write a detailed note on ferrimagnetic materials.

Seat No.	

Set P

M.Sc. Physics (Energy Studies) (Semester - I) (New) (NEP CBCS)
Examination: March/April - 2025
Analog and Digital Electronics (2322106)

Day & Date: Monday, 19-May-2025 Max. Marks: 60
Time: 03:00 AM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) If a signal passing through a gate is inhibited by sending a LOW into one of the inputs, and the output is HIGH, the gate is a(n):
   a) AND b) NAND
   c) NOR d) OR

2) Which of the following is true about microprocessors?
   a) It has an internal memory
   b) It has interfacing circuits
   c) It contains ALU, CU, and registers
   d) It uses Harvard architecture

3) What is a shift register that will accept a parallel input, or a bidirectional serial load and internal shift features, called?
   a) tristate b) end around
   c) universal d) conversion

4) The output of an AND gate with three inputs. A, B, and C, is HIGH when _____.
   a) A = 1, B=1, C=0 b) A=0, B=0, C=0
   c) A=1, B=1, C=1 d) A=1, B=0, C=1

5) An ideal operational amplifier has _____.
   a) infinite output impedance b) zero input impedance
   c) infinite bandwidth d) All of the above

6) A series dissipative regulator is an example of a _____.
   a) linear regulator b) switching regulator
   c) shunt regulator d) dc-to-dc converter

7) The output of a NOR gate is HIGH if _____.
   a) all inputs are HIGH b) any input is HIGH
   c) any input is LOW d) all inputs are LOW

8) Which of the following logical operations is represented by the + sign in Boolean algebra?
   a) inversion b) AND
   c) OR d) Complementation

B) Fill in the blanks or Write True/False. **04**

1) The output voltage of a voltage buffer is _____ with the input voltage.
2) Op-amp circuits are used in _____ voltmeters.
3) A microprocessor with the necessary support circuits will include at least two memory ICs: ROM or EPROM, and a RAM. True/ False
4) Programs written for the 8080A must have slight modifications to run on the 8085A.True/False

Q.2 Answer the following. (Any Six) **12**

a) Define the term common mode rejection ratio.
b) What are the operations performed by ALU of 8085.
c) What is instrumentation amplifier.
d) Define slew rate.
e) What is Input bias current.
f) Define voltage regulator.
g) What is opcode fetch cycle.
h) Define differential gain related to a differential amplifier

Q.3 Answer the following. (Any Three) **12**

a) Draw the circuit diagram of an Op-amp based Wein bridge oscillator?
b) List the Software and Hardware interrupts of 8085?
c) Describe some of the characteristics of practical Op-amp?
d) Show the logic diagram of SR flip-flop with four NAND gate?

Q.4 Answer the following. (Any Two) **12**

a) What is switching regulator? What are the types of switching regulator? Explain them in details with suitable figure?
b) Draw the circuit of summing amplifier using inverting amplifier configuration.
Write an equation for the output voltage for this circuit
c) Explain briefly about bus structure of 8085.

Q.5 Answer the following. (Any Two) **12**

a) What is comparator? How it can be used to produce a square -wave at the output from a Sine-wave?
b) Draw and explain the architecture of 8085 microprocessor.
c) Explain the difference between combinational & Sequential circuits.

Seat No.	

Set **P**

M.Sc. Physics (Energy Studies) (Semester - I) (New) (NEP CBCS)
Examination: March/April - 2025
Research Methodology in Physics (2322105)

Day & Date: Saturday, 24-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) The main problem in questionnaire is _____.
a) Accessible to Diverse Respondent
b) Greater Anonymity
c) Shows an inability of respondent to provide information
d) None of these

2) UV-V is spectroscopy cannot analyze compounds that _____ with light.
a) don't interact b) interact
c) merge d) none of the above

3) By selecting laser operating conditions, control over microstructure is _____.
a) possible b) impossible
c) not defined d) both a) and b)

4) In DC sputtering, _____ bias is applied to the target material.
a) Negative b) Positive
c) No d) All of the above

5) Resistive thermal deposition can deposit materials with low _____ points.
a) boiling b) decimal
c) melting d) none of the above

6) HRTEM provides _____ images.
a) medium resolution b) poor resolution
c) low resolution d) high resolution

7) Qualitative methods are probably the oldest of all the scientific techniques, the method of Qualitative research is _____.
a) Questionnaire b) Attitude Scales
c) Depth Interview d) Observation

8) Electronic interview can be conducted by _____.
a) Telephonic b) Fax
c) Personal d) All of the above

B) Fill in the blanks OR write True / False: **04**

1) In PLD, kinetic energies of ablated particles are high enough to promote surface diffusion. (True/False)
2) In thermal evaporation, films in the thickness range of angstroms to microns are obtained. (True/False)
3) _____ sampling is a probability sampling method.
4) In _____ sputtering, magnets behind cathode trap electrons.

Q.2 Answer the following. (Any Six) **12**

a) What are the applications of UV-Vis Spectroscopy?
b) State the physical conditions of DC and RF sputtering.
c) Define Quantitative research method.
d) State the various tools for data analysis.
e) Draw the neat labeled diagram of electrodeposition method.
f) What are the applications of FTIR Spectroscopy.
g) Enlist the Data Processing strategies.
h) Write the applications of Pulsed Laser Deposition.

Q.3 Answer the following. (Any Three) **12**

a) Write a note on Patents.
b) Draw the neat labeled diagram of HRTEM instrument.
c) Define physical and chemical vapour deposition.
d) Write a note on Applied Vs. Fundamental research methods.

Q.4 Answer the following. (Any Two) **12**

a) Explain different techniques and methods of good sampling.
b) Write in detail about the concept of Chemical Bath Deposition.
c) Write in detail about the construction and working of SEM.

Q.5 Answer the following. (Any Two) **12**

a) Write a note on Review of Literature.
b) What is Research Methodology? What are the requisites for Good Scientific Research?
c) Explain the construction and working of Fourier Transform Infrared Spectroscopy.

Seat No.	

Set P

M.Sc. Physics (Energy Studies) (Semester - II) (New) (NEP CBCS)
Examination: March/April - 2025
Quantum Mechanics (2322201)

Day & Date: Wednesday, 14-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) Raising operator is defined as _____.
a) $L_x + iL_y$ b) $L_x - iL_y$
c) $iL_z - iL_y$ d) $iL_x - iL_z$

2) Momentum of particle by de-Broglie relation is _____ to its wavelength.
a) inversely proportional b) directly proportional
c) in phase d) out of phase

3) Potential energy of a particle in harmonic oscillator having mass m is _____.
a) $m\omega^2 x^2$ b) $(1/2)m\omega^2 x^2$
c) $mr\omega^2$ d) $(1/2)mv^2$

4) If Ψ_a and Ψ_b are said to be orthogonal to each other, then which of the following is true.
a) $\langle \Psi_a | \Psi_b \rangle = 1$ b) $\langle \Psi_a | \Psi_b \rangle = \infty$
c) $\langle \Psi_a | \Psi_b \rangle = \sqrt{1/2}$ d) $\langle \Psi_a | \Psi_b \rangle = 0$

5) The commutation relation between $[x, P_x]$ and $[\partial/\partial x, x]$ is _____.
a) $i\hbar, 0$ b) $0, i\hbar$
c) $-i\hbar, 1$ d) $i\hbar, 1$

6) The eigen value of L^2 is _____.
a) $l(l+1)\hbar^2$ b) $l(l-1)\hbar$
c) $l(l^2+1)\hbar^2$ d) $l(l+1)\hbar$

7) The minimum energy of particle confined to one dimensional rigid box is by substituting n equal to _____.
a) one b) zero
c) half d) two

8) The eigen value of spin matrices are _____.
a) ± 2 b) 0
c) ± 1 d) ∞

B) Fill in the blanks OR write true/false. **04**

1) Inner product of bra and ket in Quantum Mechanics is always 1. (True/False)
2) Probability density is always positive. (True/False)
3) For a free particle the potential energy $V(x) =$ _____.
4) The linear momentum operator is given by _____.

Q.2 Answer the following. (Any Six) **12**

a) Define Hamiltonian operator.
b) Write about the energy of harmonic oscillator.
c) What is the probability density?
d) Define the orthogonality and normalization.
e) Write in short about the Dirac delta function.
f) What is Compton effect?
g) What is meant by rigid box?
h) What is a complex function? Give an example.

Q.3 Answer the following. (Any Three) **12**

a) State and prove Ehrenfest theorem Part II.
b) Prove that group velocity (V_g) is equal to velocity of material of particle (V).
c) Define the different postulate of Quantum mechanics.
d) Explain unitary transformation.

Q.4 Answer the following. (Any Two) **12**

a) What is Schrodinger wave equation? Write in detail about Schrodinger time independent wave equation.
b) State and explain Heisenberg uncertainty principle in Quantum Mechanics with an example.
c) Discuss eigen values and eigen functions for a particle in three-dimensional infinite potential well.

Q.5 Answer the following. (Any Two) **12**

a) Obtain eigen values of operators L^2 and Lz.
b) Describe the Pauli spin matrices.
c) Explain
i) Schartz's Inequality
ii) State vector
iii) Span
iv) Basis

Seat No.	

Set **P**

M.Sc. Physics (Energy Studies) (Semester - II) (CBCS) Examination: March/April - 2025
Electrodynamics (MSC04202)

Day & Date: Friday, 16-May-2025 Max. Marks: 60
Time: 11:00 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) The electrostatic energy in an electric field does not depend on which of the following?
   a) Magnitude of charges b) Permittivity
   c) Applied electric field d) Flux lines

2) If the electric potential is given, which of the following cannot be calculated?
   a) Electrostatic energy b) Electric field intensity
   c) Electric flux density d) Permittivity

3) Electric field intensity is a _____ quantity.
   a) Scalar b) Vector
   c) Both (a) and (b) d) None of the above

4) The skin effect is a phenomenon observed in _____.
   a) Insulators b) Dielectrics
   c) Conductors d) Semiconductors

5) Lorentz electric force has direction_____.
   a) Similar to electric field b) Opposite to electric field
   c) Scalar quantity d) None of these

6) Electric intensity at any point in an electric field is equal to the at that point.
   a) Electric flux b) Magnetic flux density
   c) Potential gradient d) None of the above

7) The Biot-Savart's law is a general modification of _____.
   a) Kirchhoff’s law b) Lenz's law
   c) Ampere's law d) Faraday's laws

8) The skin depth is used to find which parameter?
   a) DC resistance b) AC resistance
   c) Permittivity d) Potential

B) Write True/False. **04**

1) The work done in moving a test charge from one point to another in an equipotential surface is zero.
2) When curl of a path is zero, the field is said to be conservative.
3) In static magnetic field only magnetic dipole exist.
4) The magnetic field intensity will be zero inside a conductor.

Q.2 Answer the following. (Any Six) **12**

a) State Biot-Savart law.
b) Explain the electromagnetic force.
c) How electromagnetism works?
d) Define Poynting vector.
e) What is an electric field?
f) Write Maxwell equation derived from Faradays law.
g) What is an electromagnetic wave?
h) Define Skin effect.

Q.3 Answer the following. (Any Three) **12**

a) Explain differential form of Ampere's law.
b) Explain energy stored in electric field.
c) State the boundary condition for an electrostatic field $\bar{E}$.
d) Explain Maxwell displacement current.

Q.4 Answer the following. (Any Two) **12**

a) What is gauss law? Explain differential form of its.
b) Discuss electromagnetic plane waves in stationary medium.
c) Explain the concept of Thomson cross section.

Q.5 Answer the following. (Any Two) **12**

a) Explain boundary condition between conductor and free space.
b) State and prove Poynting theorem.
c) Explain in short radiation from a half wave antenna.

Seat No.	

Set P

M.Sc. Physics (Energy studies) (Semester - II) (New) (NEP CBCS)
Examination: March/April - 2025
Classical Mechanics (2322206)

Day & Date: Tuesday, 20-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) _____ the constraints are independent of time.
a) Holonomic b) Non-holonomic
c) Scleronomous d) Rheonomous

2) The phase space refers to _____.
a) Position coordinates
b) Momentum coordinates
c) Both Position and Momentum coordinates
d) Cyclic coordinates

3) Which is true mathematical statement of 2nd law of Newtonian mechanics?
a) F=m/a b) F=ma
c) F=m+a d) F=m-a

4) _____ for circular orbit the value of eccentricity.
a) $\in > 1$ b) $\in < 1$
c) $\in = 1$ d) $\in = 0$

5) Newton's laws of motion are _____ under Galilean transformation.
a) Invariant b) Variant
c) changes its form d) changes its sign

6) Degrees of freedom for fly wheel _____.
a) 0 b) 1
c) 3 d) 5

7) Which of the following is true for Poisson bracket?
a) [X,Y]= [Y,X] b) [X,Y]=2[Y,X]
c) [X, Y]= -[Y,X] d) [X,X]=[Y,Y]=1

8) The generating function F1(q,Q,t) generates _____ transformation.
a) Identity b) Exchange
c) Zero d) Infinite

B) Fill in the blank OR true /False. **04**

1) The motion of the planets around the sun is the example of the motion under central force field. (True/False)
2) In Lagrange's equation, the motion of the system has been described by force. (True/False)
3) The equation of Jacobi's Identity is _____.
4) As per Kepler's third law of planetary motion, square of a time period is directly proportional to cube of a _____.

Q.2 Answer the following. (Any Six) **12**

a) Define central force and give its characteristics?
b) How to analyse the orbits?
c) What is the Jacobi integral?
d) Define the conservation of linear and angular momenta.
e) Write in short about the open system.
f) What is Euler-Lagrangian differential equation?
g) Write the condition for transformation to be canonical.
h) What is the constant of motion?

Q.3 Answer the following. (Any Three) **12**

a) Give an account about conservation of energy in case of mechanics of particles.
b) What are constraints? Explain in detail about their types with suitable examples.
c) Check whether the transformation defined as $Q=1/p$, $P=qp^2$ is canonical or not.
d) State Hamilton's variational principle and derive the Lagrange's equation of motion form it?

Q.4 Answer the following. (Any Two) **12**

a) Explain
1) Gauge invariance of Lagrangian equation
2) Gyroscopic forces
b) Explain and prove the principle of least action.
c) Derive an equivalent equation for reduction to one body problem from two body problem.

Q.5 Answer the following. (Any Two) **12**

a) Elaborate the differences between Classical Mechanics and Quantum Mechanics.
b) Apply the Hamilton's equations to derive the equations of motion for simple pendulum and linear harmonic oscillator.
c) Write short note on
1) Artificial Satellite
2) Rutherford scattering

Seat No.	

Set P

M.Sc. Physics (Energy Studies) (Semester - III) (New) (NEP CBCS)
Examination: March/April - 2025
Statistical Physics (2322301)

Day & Date: Thursday, 15-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figure to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) First and second law of thermodynamics are related by the relation
a) dU=TdS-VdP b) dU=TdS+PdV
c) dU=PdV-TdS d) dU=TdS-PdV

2) Helmholtz function is the amount of useful work done by a thermodynamic system at constant ____.
a) pressure
b) temperature and volume
c) temperature and pressure
d) pressure and volume

3) "At absolute zero the entropy of pure crystal is zero" is the statement of which law of thermodynamics?
a) First law b) Second law
c) Third law d) Fourth law

4) In a grand canonical ensemble, a system A of fixed volume is in contact with a large reservoir B. Then ____.
a) A can exchange neither energy nor particles with B
b) A can exchange only energy with B
c) A can exchange both energy and particles with B
d) A can exchange only particles with B

5) In which process the pressure of the system remains constant?
a) isothermal process b) isobaric process
c) isometric process d) isochoric process

6) In Maxwell relations, $(\partial \mathrm{T}/\,\partial \mathrm{V})s = ?$
a) $-(\partial \mathrm{V}/\,\partial S)_{\mathrm{T}}$ b) $-(\partial \mathrm{P}/\,\partial S)_{\mathrm{V}}$
c) $(\partial S/\,\partial \mathrm{P})_{\mathrm{T}}$ d) $(\partial S/\,\partial \mathrm{V})_{\mathrm{T}}$

7) What does occur at a critical point in critical phenomenon?
a) phase transition b) symmetry breaking
c) universality d) scaling laws

8) Electron is an example of which statistics?

a) Bose Einstein statistics b) Maxwell Boltzmann statistics

c) Fermi Dirac statistics d) None

B) Fill in the blanks OR write true/false: **04**

1) Entropy and temperature are the canonical pair. (True/False)
2) During a phase change, the temperature of a substance remains constant. (True/False)
3) The average K.E. of a harmonic oscillator is ____.
4) In BE statistics particles have ____ spin.

Q.2 Answer the following question (Any Six). **12**

a) Which physical quantity remains constant during the process of phase transition?
b) Write one example of first order phase transition.
c) Name the statistics obeyed by photon and electron.
d) What is thermodynamic potential?
e) Write about statistical ensemble.
f) What is phase space?
g) What is the entropy of system?

Q.3 Answer the following (Any Three). **12**

a) Write a note on chemical potential.
b) Discuss about the thermodynamic system.
c) Write about the condition for phase equilibrium.
d) Write a note on probability calculation.

Q.4 Answer the following (Any Two). **12**

a) Write a note of Black body radiation and Planck distribution.
b) Draw and discuss the diagram of an oscillator in phase space.
c) Define and explain the laws of thermodynamics with examples.

Q.5 Answer the following (Any Two). **12**

a) State and discuss the Ehrenfest equations.
b) Write in detail about the Maxwell-Boltzmann statistics.
c) Explain about the statistical ensembles and their types.

Seat No.	

Set P

M.Sc. Physics (Energy Study) (Semester - III) (New) (NEP CBCS)
Examination: March/April - 2025
Atomic & Molecular Physics (2322302)

Day & Date: Saturday, 17-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) The singlet system of helium for S = 0 is called ____.
a) Para-helium b) a positively helium ion
c) Ortho-helium d) a negatively helium ion

2) Which of the following cannot be conserved during Raman scattering?
a) Total Energy b) Momentum
c) Kinetic Energy d) Electronic Energy

3) Transition of an electron from various s levels to lowest p level gives____
a) sharp series b) principle series
c) diffuse series d) fundamental series

4) In case of LS coupling l_1= 1, l_2 = 2, then J = ____.
a) 1,2,3,4 b) 0,1,2,3
c) 2,3,4 d) 0,1,2,3,4

5) With increasing quantum number, energy difference between adjacent levels in atoms ____.
a) decreases b) increases
c) remain constant d) zero

6) Atomic spectra is an example of ____
a) line spectra b) continuous spectra
c) band spectra d) both a and b

7) The orientation of atomic orbitals depends on their ____.
a) Spin quantum number
b) Magnetic quantum number
c) Azimuthal quantum number
d) Principal quantum number

8) Symmetric top molecules have _____.

a) $I_A=I_B=I_C$ b) $I_A=I_B\neq I_C$

c) $I_A\neq I_B=I_C$ d) $I_A=O$, $I_B\neq I_C$

B) Write true/false. **04**

1) Splitting of spectral lines in an atom in presence electric field is called Stark effect. (True/False)
2) If Q value of nuclear reaction is positive the reaction is Exothermic. (True/False)
3) Spin angular momentum depends on s. (True/False)
4) The electronic spectra are observed in far IR region. (True/False)

Q.2 Answer the following (Any Six). **12**

a) What are the quantum states of an electron in an atom?
b) Define interaction energy of an atom.
c) Write about the Paschen back effect.
d) Define covalent interaction.
e) What is meant by diatomic molecule?
f) Define dissociation energy.
g) Write about the binding energy of an atom.

Q.3 Answer the following (Any Three) **12**

a) Write in brief on two valence electron spectra.
b) Discuss about origin of spectral line.
c) State and explain Pauli's Exclusion Principle.
d) Write a note on the vibrating diatomic molecule.

Q.4 Answer the following (Any Two) **12**

a) Write in detail about the jj coupling.
b) Discuss about the X-ray and Auger transition.
c) Write a note on Raman spectra.

Q.5 Answer the following (Any Two). **12**

a) What is hyperfine structure? Elaborate.
b) Explain in detail about anharmonic oscillator.
c) Discuss in detail about the spectrum of a non-rigid rotator.

SLR-AA-19

Seat No.	

Set P

PHYSICS(ENERGY STUDIES) SEM–III (Old) (CBCS) Examination: March/April - 2025
Materials Characterization (MSC40307)

Day & Date: Monday, 19-May-2025 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q.Nos.1 and 2 are compulsory.
2) Attempt any three questions from Q.No.3 to Q.No.7.
3) Figure to right indicate full marks.

Q.1 A) Choose correct alternative. **10**

1) SI unit of thermal conductivity is given as _____
a) WmK^{-1} b) $Wm^{-1}k^{-1}$
c) Wm^2K d) Wm^2k^2

2) The representation of Beer Lambert's law is given as A = abc. If 'A' represents absorption, 'b' represents distance and 'c' represents concentration, what does 'a' represent?
a) Intensity b) Transmittance
c) Absorptivity d) Admittance

3) X-ray diffractometers provide ____ information about the compounds present in a solid sample.
a) Quantitative
b) Qualitative
c) quantitative and qualitative
d) Either quantitative or qualitative

4) There are ____ main components in all spectrometers.
a) Three b) Five
c) Two d) Ten

5) By multiplying pumping speed by pressure at which that pumping speed occurs, we get a measure called as ____
a) vapour pressure b) Throughput
c) Density d) normal flow

6) The ____ is a mathematical function describing amplitude and phase of a wave diffracted from crystal lattice.
a) diffraction factor b) atomic factor
c) intensity factor d) structure factor

7) In Hall effect, ____ is exerted on the charge carriers.
a) Lorentz force b) Centripetal force
c) Mechanical force d) All of these

8) Radio waves have the ____ wavelength in the electromagnetic spectrum.
a) Longest b) Shortest
c) both (a) and (b) d) none of these

9) In four probe method, voltage is read across ____ inner probes.
a) Four b) Three
c) Two d) both (b) and (c)

10) DTA stands for ____.
a) Distribution Thermal Analysis
b) Destructive Thermal Analysis
c) Dimensional Thermal Analysis
d) Differential Thermal Analysis

B) Fill in the blanks or State True/False: **06**

a) Thermogravimetric analysis is used for measuring thermal stability. (True/False)
b) The oil in Rotary pump doesn't provide seal between rotor and pump ring. (True/False)
c) Gamma rays have the shortest wavelength in the electromagnetic spectrum. (True/False)
d) In a cubic lattice, all the angles are equal to ____ degrees.
e) In semiconductors having positive Hall coefficient, ____ are majority carriers.
f) Refractive index has ____ unit.

Q.2 Answer the following: **16**

a) What are the different factors affecting the intensity in Powder X-ray Diffraction?
b) State the various Resonance techniques and mention their necessities in short.
c) Draw the neat labelled diagram showing construction of UV-Vis absorption spectroscopy.
d) State the postulates of kinetic theory of gases.

Q.3 Answer the following: **16**

a) Describe in detail about absorption, refection and transmission in materials.
b) Explain in detail about the working principle of Roots pump.

Q.4 Answer the following **16**

a) What is a spectrometer? Explain its working and applications

b) Elaborate the basic principle of electrical transport in metals and semiconductors.

Q.5 Answer the following **16**

a) Explain the working of a Rotary Oil pump.

b) Describe the technique of measurement of band gap in solids using Photoluminescence spectroscopy.

Q.6 Answer the following **16**

a) Explain the Four probe method for conductivity measurement.

b) Using the kinetic theory of gases, obtain an expression for the relation between total kinetic energy, pressure, and volume of the gas.

Q.7 Answer the following **16**

a) Explain the methods of sample preparation.

b) Describe in detail about the Hall effect in semiconductors.